Noise and Advanced Hearing Protection

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DISTRIBUTION STATEMENT A.
Approved for public release.

NAVAIR Control #6SPR244 dated 14Mar06.

Outline

- **Noise**
  - **Noise Levels Near Military Jets**
  - **Safe Noise Exposure Limits**
  - **Current Double Hearing Protection**
  - **In Perspective - Flight Deck Noise-Hazard Zone**
  - **Real-world Hearing Protection**
  - **The Cost of Noise**
- **New Hearing Protection and Comm Technologies**
  - **Closing the Gap**
  - **Help us Help You**
- **Summary**

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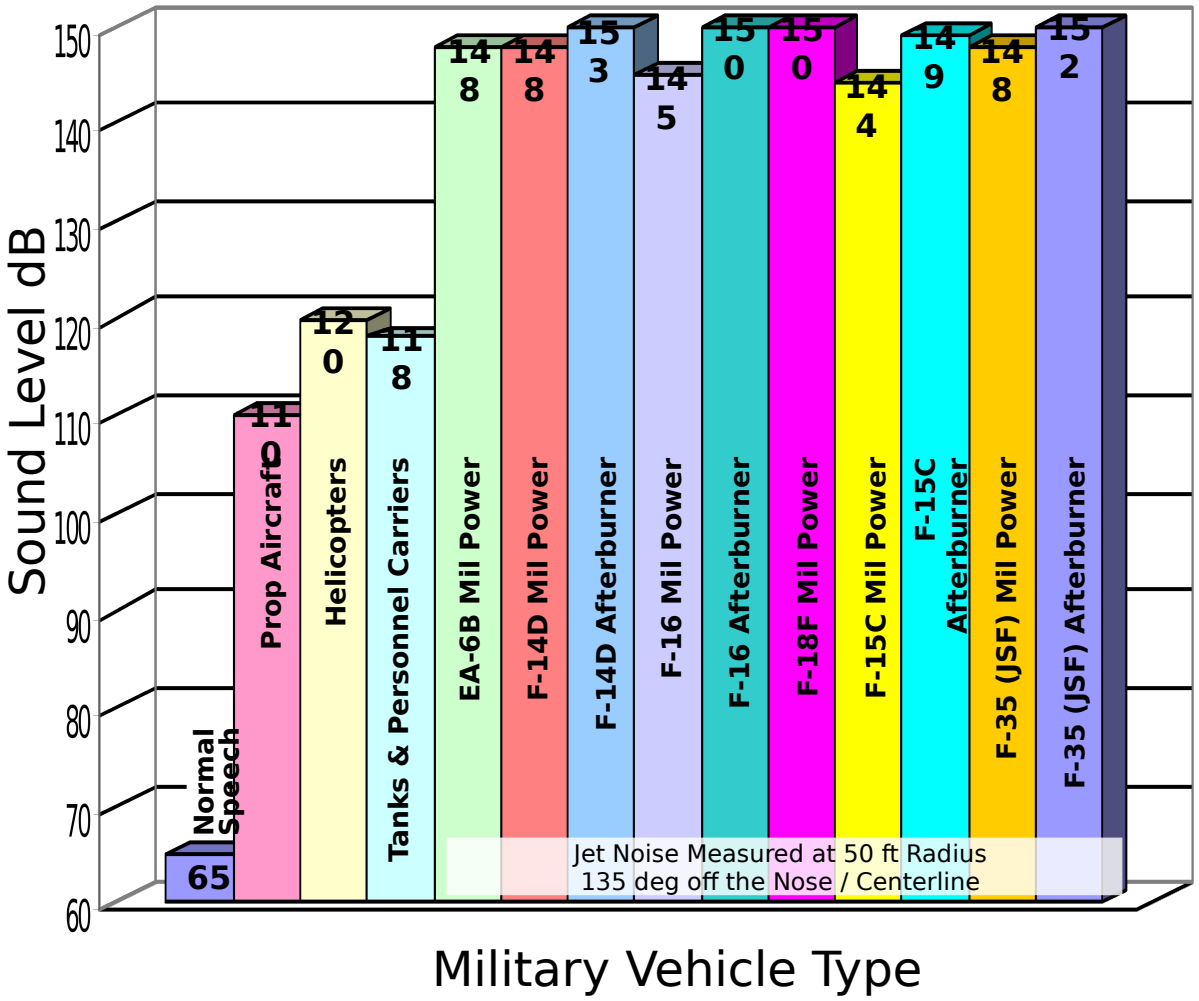
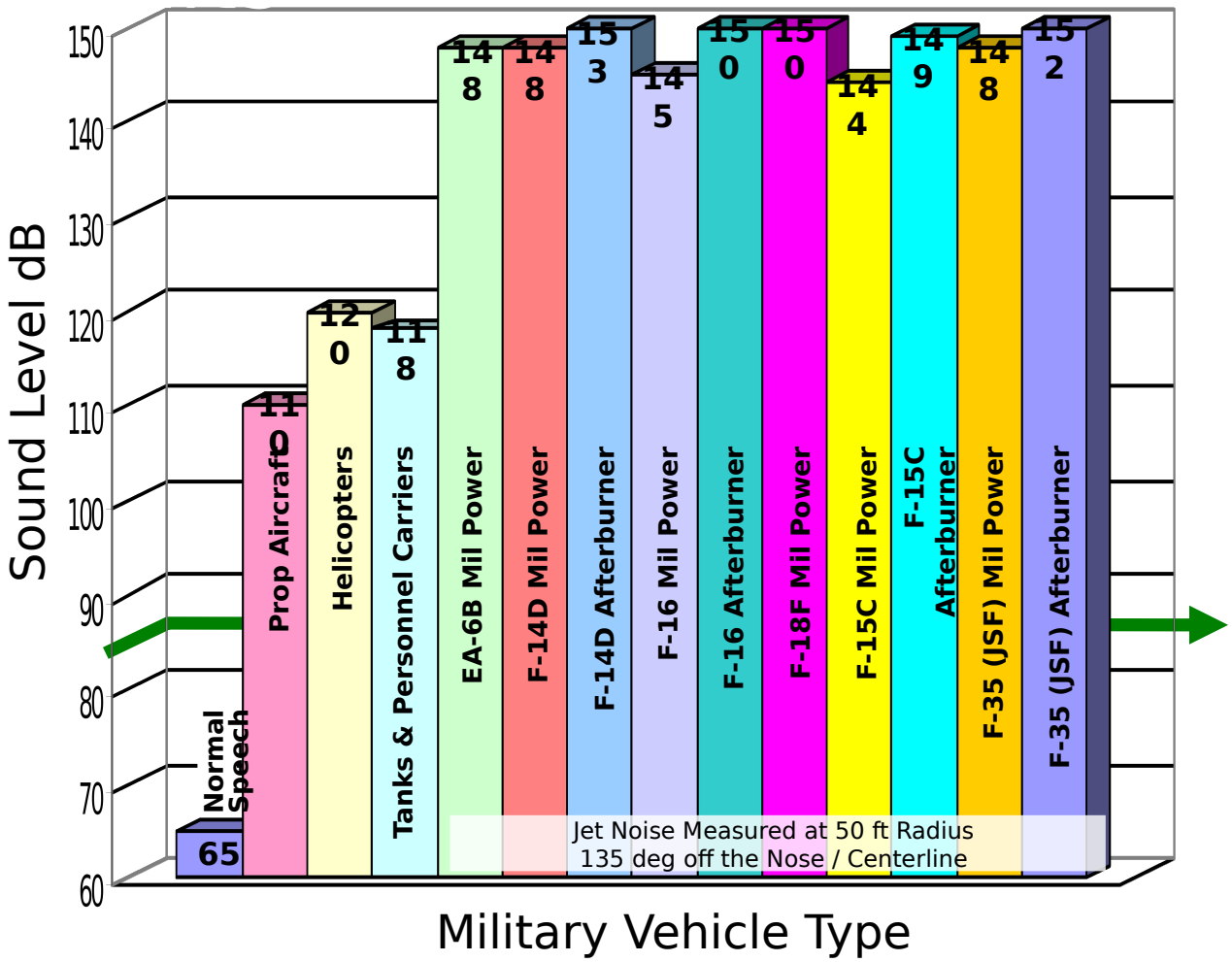
Military Vehicle Noise



Military Vehicle Noise & Safe Exposure



8 hour daily average noise exposure should not exceed 84 dBA

For every 4 dBA above this, exposure time should be cut in half

US Navy safe noise exposure limit is less stringent than DoD, Air Force, and Army limits which are set at 85 dBA for an 8 hour time weighted average with a 3 dBA doubling rate

Safe Noise Exposure Limits

Working in noise greater than 104 dBA, you must wear double hearing protection

Hearing Conservation Instructions

(all available online)

- **OPNAVINST 5100.23**
- **OPNAVINST 5100.19**
- **NEHC TM 6260.51.99-2**
  (replaced BUMEDINST and NAVMEDCOMINST 6260.5)
- **MCO 6260.1E**
- **DODINSTR 6055.12**

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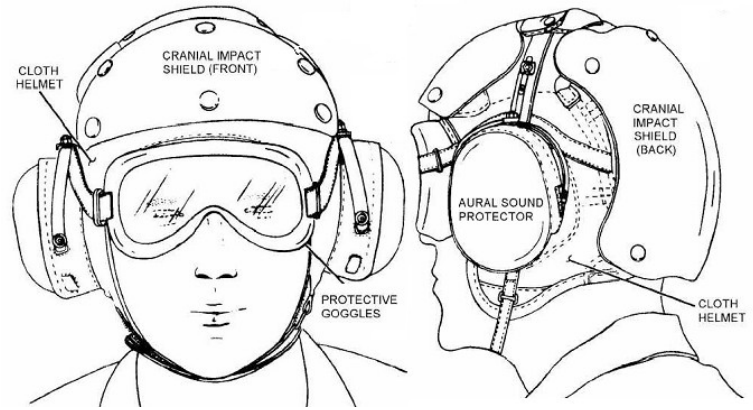
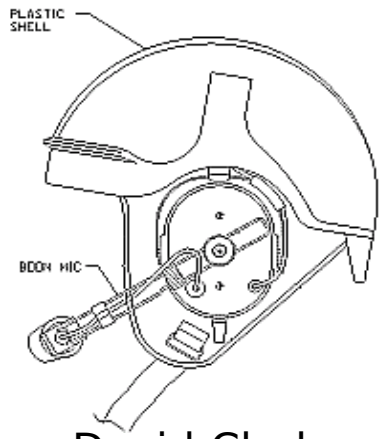
Current Double Hearing Protection

Disposable

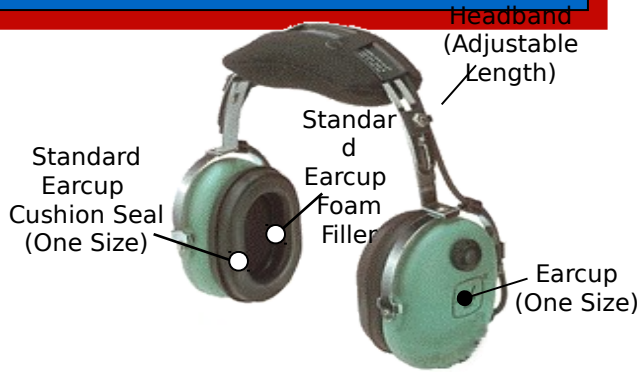
DOUBLE HEARING PROTECTION = If worn correctly, earplugs under earmuffs provide approx. 30 dB of hearing protection



HGU-25(V)2/P Flight Deck Crew Helmet "Cranial"



David-Clark K10 Radio "Cranial"



Sound Aural Protector "Earmuffs

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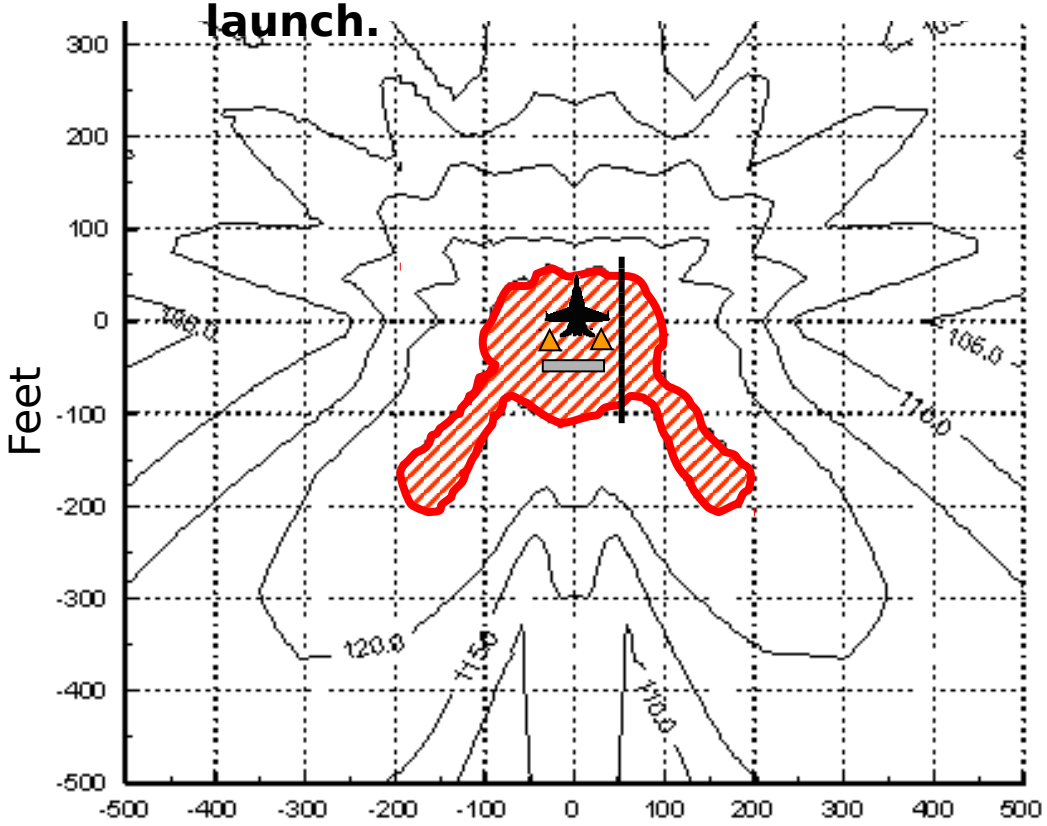
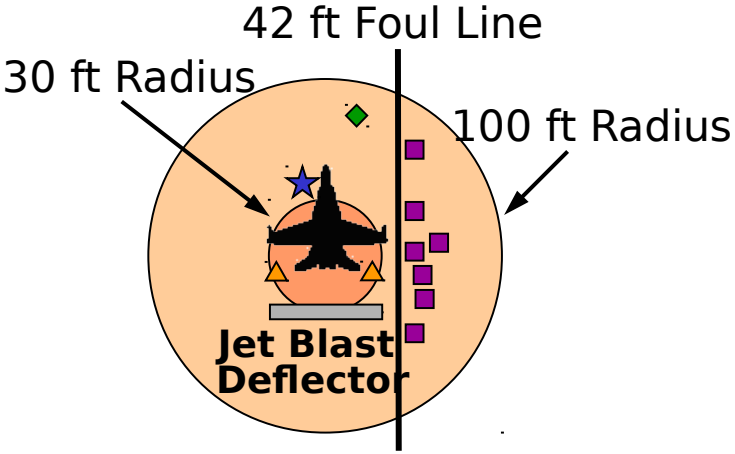
Flight Deck Noise in Perspective

F-18C EXAMPLE:

Crews wearing current double hearing protection exceed the safe daily noise exposure limit with about 60 aircraft launches in a 24 hour period--sooner if exposed to other hazardous noises throughout the day.

Some positions like Final Checker can exceed the safe limit in 1 launch.





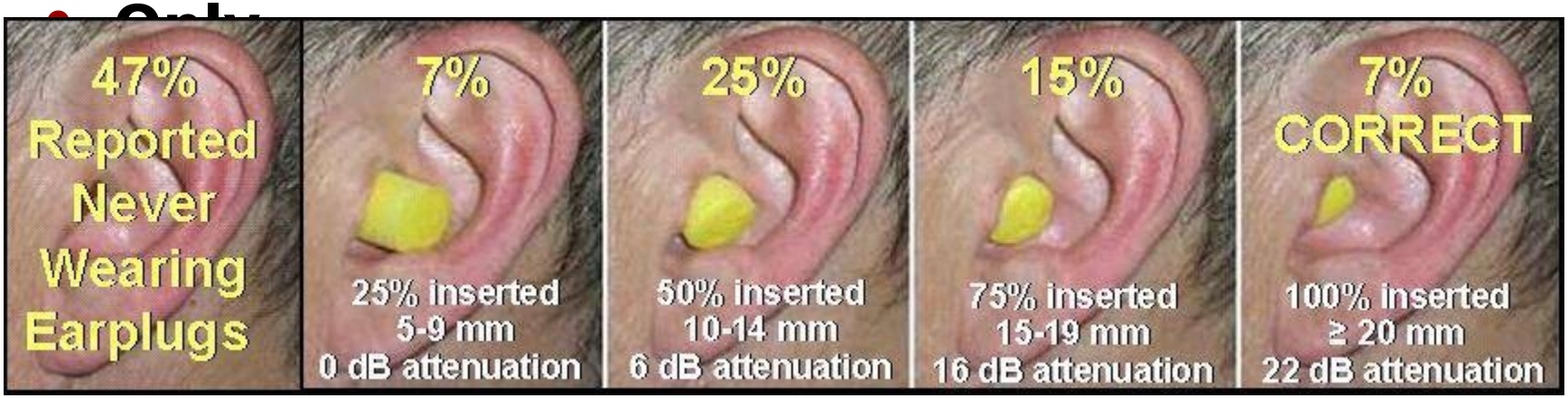
- Plane Captain (≈ 125 dB)
- Final Checker (≈ 135 dB)
- Final Checker Finish (≈ 150 dB)
- Deck Crew at Foul Line (120-150 dB)

(Depends on Location)

Real-World Hearing Protection

Interviewed 300 Flight Deck Crews from 4 CVN and 2 LHD / East and West Coast

- **79% Reported always wearing earplugs**
- **Getting an estimated 0 - 6 dB attenuation due to either shallow insertion or not wearing earplugs at all**
- **Only**



Noise Reduction Ratings from earplug insertion depth study completed by the Air Force Research Laboratory using American National Standard S12.6-1997 (R2002) Methods for Measuring the Real-Ear Attenuation of Hearing Protectors, Method A (Experimenter Supervised / Verbally Coach), mean minus two standard deviation

Real-World Hearing Protection

- **Deck crews apt to wear just a cranial, LSOs tend to wear just earplugs**
- **LSO inadequate hearing protection likely results in hearing loss and ultimately opposes their desired effect**
  - **Reduces speech intelligibility**
  - **Lessens discrimination of approaching aircraft engine noises**

How would you rate this single hearing protector earplug use?

Real-World Hearing Protection

- **Cranial provides ≈21 dB protection (without earplugs)**
  - **When correctly fit, worn, and maintained**
- **Leaks between earcup & head reduce protection 3-15 dB**
  - **By letting noise in the earcups**

Things that Reduce Cranial Hearing Protection

Wrong Size or Poor Fit

ex: small crew issued largest of four sizes

Poorly Maintained Equipment

ex: hard, creased earcup cushions & missing foam

Clothing Worn Under Earcup Seal

ex: bandanas, do-rags, ear warmers

Eyeglass Temples

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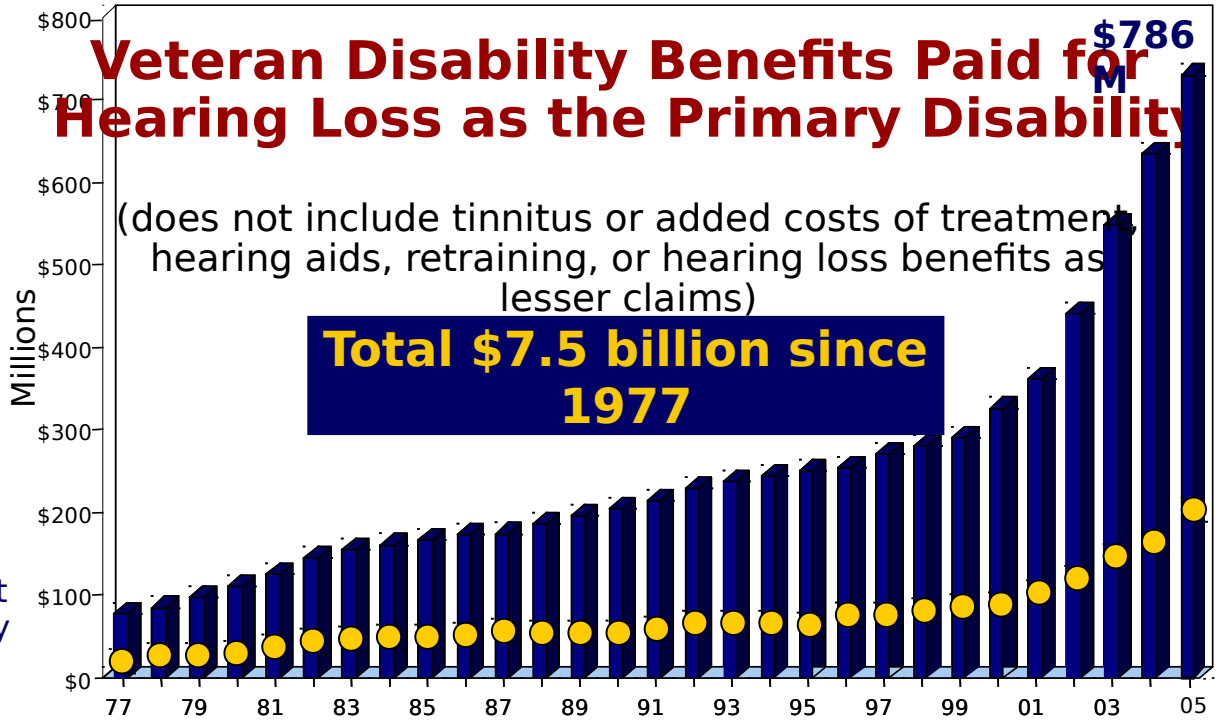
The Cost of Noise



Navy & Marine Veterans Account for Approximately 25%

By the time a person has a compensable hearing loss, they are truly disabled--hard-pressed to understand speech when more than one person is speaking.

- **Keep in mind, these people didn't suddenly have a hearing loss at the 20 year retirement point**
- **Have to assume some engaged today in military operations**
  - **Impaired ability to 100% understand speech and radio comm**
  - **Reduced quality of life when they know there are sounds they are missing**
- **For people who work in high noise environments, studies show only about 4% of noise induced hearing loss is due to non-occupational noise exposure like loud music, farm**

Re-Cap of Main Points so Far

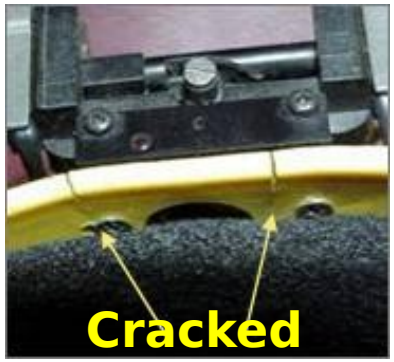
- **84 dBA-8-4 US Navy safe limit for 8 hour exposure (time weighted avg) with 4 dBA doubling rate**
- **130-150 dB Maximum noise 50 ft from jet aircraft launch at highest power settings**
- **104 dBA Double hearing protection is required**
- **30 dB Attenuation provided by current double hearing protection**
- **21 dB Attenuation provided from cranial alone**
- **3-15 dB Estimated reduced cranial hearing protection from poor fit and poor maintenance**
- **0-6 dB Attenuation provided by earplugs as worn by 79% of flight deck crews**
- **47% Flight deck crews who reported never wearing earplugs**
- **1 Safe number of jet launches per day that some close-in crews can be exposed to while**

Goals: New Hearing Protection &

Design to encourage 100% use rate and to be worn and maintained correctly

- **Up to 50 dB Noise Attenuation**
  - **Modular in order to tailor to different noise**
- **Clear Communications**
- **Comfortable**
  - **Designed to fit today's personnel**
  - **Account for gender and race differences**
- **No FOD hazard**
- **Engineered to Integrate**
  - **Night Vision Devices (NVDs)**
  - **Chemical, Biological, Radiological (CBR)**
  - **Fire Protection**
- **Impact Protection to ANSI Z89 level**
- **Reduced Maintenance Time and Cost**

Current day non-approved NVD mounts are unsafe and put users at risk for eye, head, and neck



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New Hearing Protection & Comm Tech

Communication Earplugs
(Joint with the Army)

Deep Insert Custom Earplugs
(Joint with the Air Force)

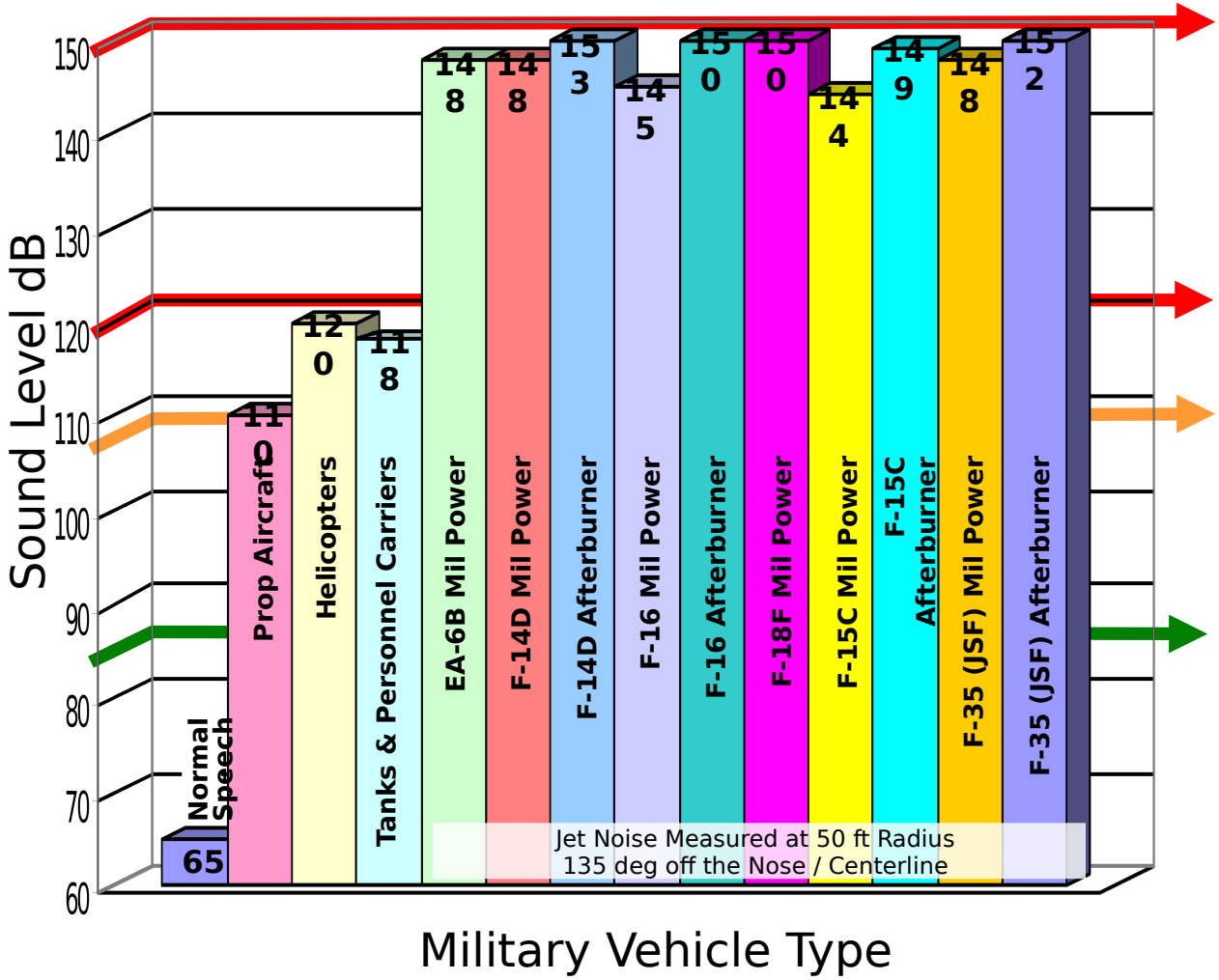
DCAT-CT Attenuator
Better Earcup Cushion, Foam Insert, and Tethered Earplug

Active Noise Reduction (ANR) Custom Earplugs
(Joint with the Air Force)

Cranial Prototypes

Noise Canceling Mic

Closing the Gap



If you are in 150 dB noise

Minus 30 dB

≈ 30 dB protection from current double hearing protection (plugs & muffs) reduces 150 dB noise to 120 dB at your ears -- you are overexposed almost immediately

Minus 42 dB

≈ 42 dB protection from custom deep insert earplugs worn under earmuffs reduces 150 dB noise to 108 dB at your ears and allows 2.4 minutes of safe daily noise exposure

So far, no feasible technology can be worn to reduce 150 dB noise to 85 dB at your ears and allow safe 8 hr exposure. You must wear the best hearing protection, wear it correctly, and retreat to quiet areas as much as possible.

Help Us Help You

- **Don’t give your hearing away to noise – preserve it**
  - **Wear <u>double</u> hearing protection and wear it correctly**
  - **Replace worn-out hearing protectors / components immediately**
  - **Some hearing lost during a work day can recover with hours of quiet – wear earplugs or earmuffs below deck and while asleep**
- **Have annual audiogram results and year-to-year changes explained to you**
- **If you have difficulty understanding comm while wearing double hearing protection file a HAZREP (can be anonymous)**
  - **HAZREPs tell the Pentagon that a need exists and helps justify funding to get better hearing protection to the fleet**
  - **HAZREPs are explained in OPNAV Instruction**

Summary

- **Flight deck noise exposures are among the worst in the world**
- **Even with current double hearing protection, hearing loss is the #1 DoD disability**
- **Flight deck noise exposures require double hearing protection to protect your hearing**
  - **You** need to wear earplugs and earmuffs to protect your hearing
  - **You** need to insert your earplugs as deeply as you can to get maximum attenuation
  - **You** need to maintain / repair your hearing protection equipment
  - **You** can not recover lost hearing
- **NAVAIR and Office of Naval Research are teamed with the Air Force, other services, and industry to develop better hearing protection and communication technology**
- **Officially report hazardous comm situations – there must be an official requirement for the Pentagon to**

Backup Slides

Earcup Foam Inserts
(NAVAIR SBIR N01-162, Adaptive Technologies, Inc., David Clark Company)

Product Description

- Intended Use: Improve passive noise reduction rating (NRR) in US Navy flight deck helmet earcups
- Primary User: Anyone using same earcup style
- Description: Foam that is custom shaped to fit inside earcups

Capabilities/Specifications

- ANSI S12.6-1997 (A) REAT testing showed NRR improved 2 dB (2 SD) over current earcup foam
- Current earcup cushion and stock foam NRR 20 (2 SD)
- Current earcup cushion and new foam insert NRR 22 (2 SD)

Availability

- Available from Aegisound, Inc.
  - Part ATI-FI-423225
  - $20.95
- New David Clark undercut earcup seals with new foam insert, NRR 24 (2 SD)
  - NSN 4240-01-524-3339 or DCCI part number: 40688G-59
  - $49.50

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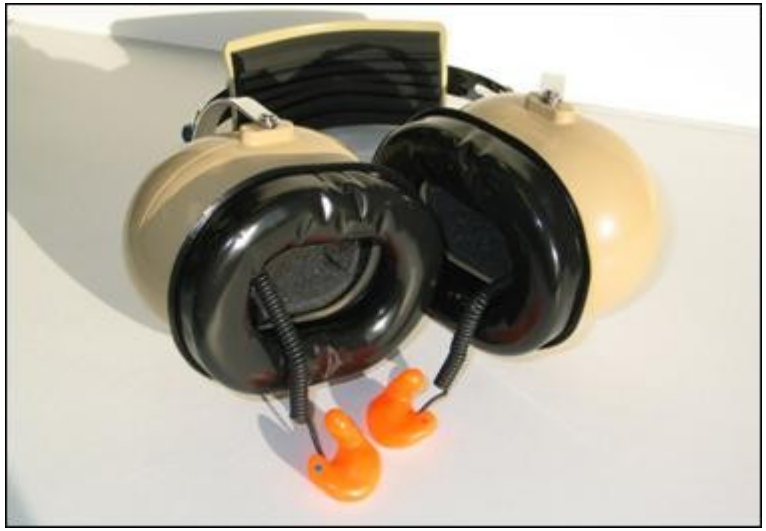
Tethered Custom Deep Insert Earplug
(NAVAIR SBIR N01-162, Adaptive Technologies, Inc., Air Force Research Laboratory)

Product Description

- Intended Use: Improve passive noise attenuation in US Navy flight deck headsets
- Primary User: Anyone using same earcup style
- Description: Solid, custom molded earplug that can be tethered to earcups

Capabilities/Specifications

- Tethered custom earplug w/ David Clark 9AN/2 cranial earcups w/ undercut seals and ATI foam inserts provided mean 43 dBA attenuation in F/A-18F jet noise
- Custom earplug provides repeatable insertion and field attenuation
- Tethering earplugs increases double hearing protection compliance and reduces threat of FOD [foreign object debris] ingestion in jet engines



Availability

- Available from Aegisound, Inc.
  - Part DCAT-CT
  - $ 350.00
  - Impressions must be arranged

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Digital Noise Canceling Microphone
(NAVAIR SBIR N01-162, Adaptive Technologies, Inc.)

Product Description

- Intended Use: Improve comm clarity in US Navy flight deck headsets
- Primary User: Anyone using a communication headset
- Description: Digital microphone that cancels ambient noise but allows speech signal to pass to listener without degradation

Capabilities/Specifications

- 90% speech intell in 115 dB pink noise
  - Used Modified Rhyme Test in ANSI S3.2 (R1999), talker / listener had same noise
- 10 dB greater noise cancellation compared to legacy boom-mount mics
- Extended noise canceling bandwidth to 4 kHz (2-3 times higher than legacy mic)

Availability

- Available in 2006 from Aegisound, Inc.
- Part number pending final contract
- Tailored to specific communication platforms upon request, e.g., oxygen mask version

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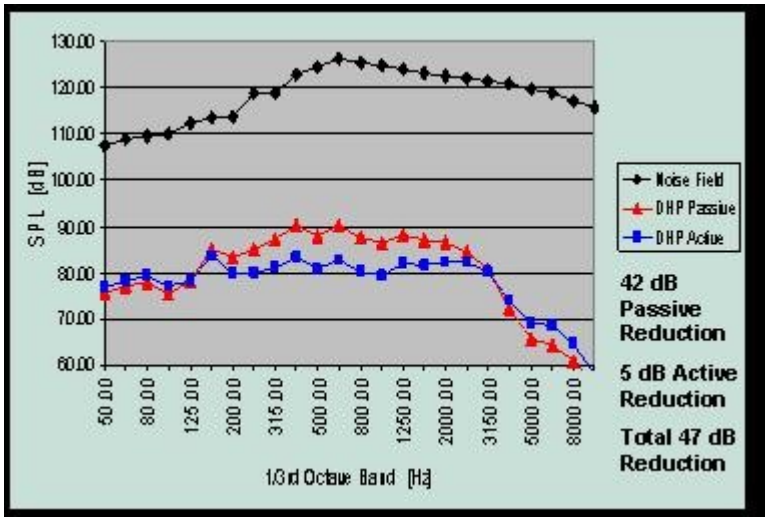
Active Noise Reduction (ANR) Earplugs
(Air Force Research Laboratory, NAVAIR SBIR N01-162, Adaptive Technologies, Inc.)

Product Description

- Intended Use: Improve hearing protection and comm clarity for military jet aircrew and flight deck/line crews
- Primary User: Personnel exposed to jet noise
- Description: Solid, custom molded ANR earplugs used with passive attenuating earmuffs

Capabilities/Specifications



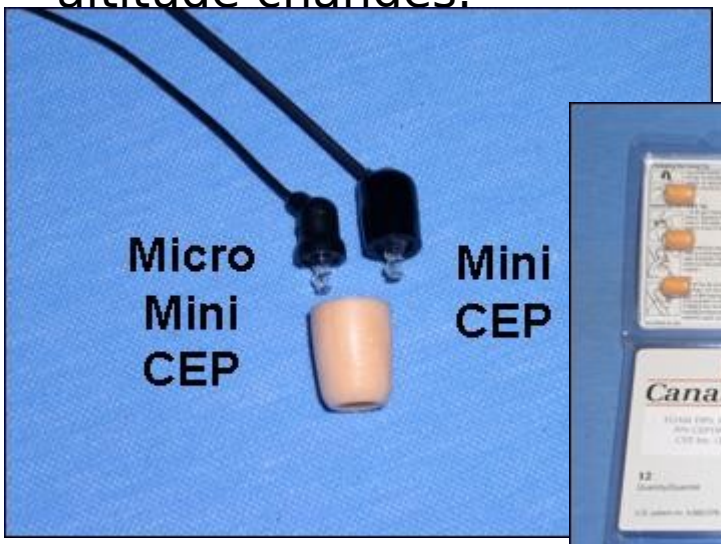
Availability

- Field testing slated for 2007
- Transition linked to Joint Strike Fighter contract to provide improved aviation personnel hearing protection
- Will be available from Aegisound, Inc.

Miniature CEPs w/ Soft Core, Macromelt Earphone & Ear Canal Vent (USArmy Aeromedical Research Lab, NAVAIR SBIR N02-151, Commun. & Ear Protection, Inc.)

Product Description

- Intended Use: US Navy aviation personnel
- Primary User: Personnel exposed to aviation noise
- Description: Smaller, more rugged version of original CEP. New soft core in foam eartip further improves comfort. Vent provides pressure equalization during rapid altitude changes.



Capabilities/Specifications

- EMI and TEMPEST approved
- Mini-CEP provides about 30 dB of noise attenuation when worn alone and adds 10 dB to helmet attenuation
- Macromelt miniature earphone is made by low pressure injection of adhesive polyamides -- protects Mini-CEP from moisture, chemical, and mech. damage

Availability

- Available from CEP, Inc.
- Kit includes mini-CEP, helmet interface, assorted eartip sizes (no aircraft mod required)
- $117.00

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Miniature CEP with Custom Molded Earplug
(NAVAIR SBIR N02-151, Communications & Ear Protection, Inc.)

Product Description

- Intended Use: US Navy aviation personnel
- Primary User: Personnel exposed to aviation noise
- Description: Option to foam eartips

Capabilities/Specifications

- Custom Mini-CEP provides mean 42 dB noise attenuation when worn alone
- Custom earplugs provide repeatable insertion and field attenuation

Availability

- Available from CEP, Inc.
- $75.00
- Ear canal impressions must be arranged and cost extra

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Hear-through Miniature CEP
(NAVAIR SBIR N02-151, Communications & Ear Protection, Inc.)

Product Description

- Intended Use: US Navy flight deck helmet
- Primary User: Personnel exposed to aviation noise
- Description: Allows user to listen to ambient carrier noise that is translated to a safer sound pressure level

Capabilities/Specifications

- Improves situational awareness of flight deck crews

Availability

- Available from CEP, Inc.
- Kit includes Hear-through mini-CEP, assorted eartip sizes
- $275.00

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Maintainer Noise Reduction Helmet
(NAVAIR SBIR N0-161/N04-255, Air Force Office of Scientific Research STTR, Creare, Inc.)

Product Description

- Intended Use: US Navy flight deck helmet
- Primary User: Personnel exposed to aviation noise
- Description: Hearing and Impact Protection Helmet

Capabilities/Specifications

- Helmet shell provides a third level of passive hearing protection
- Reduces both air and bone conducted sound transmission
- Sevenfold increase in allowable exposure over current double protection

Availability

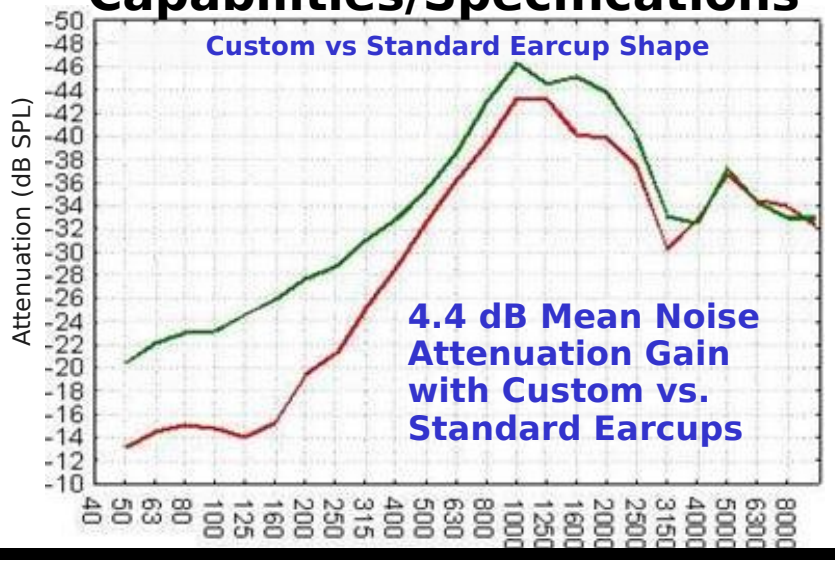
- In development.
- Prototype field testing in 2006
- Production systems available in 2008

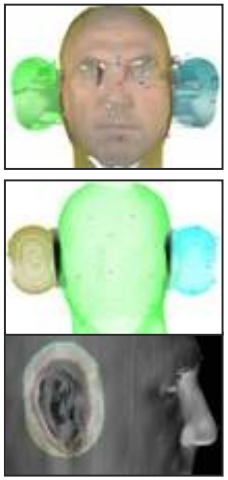
Human-Shaped Earcups
(NAVAIR (funded by Office of Naval Research), Air Force Research Laboratory

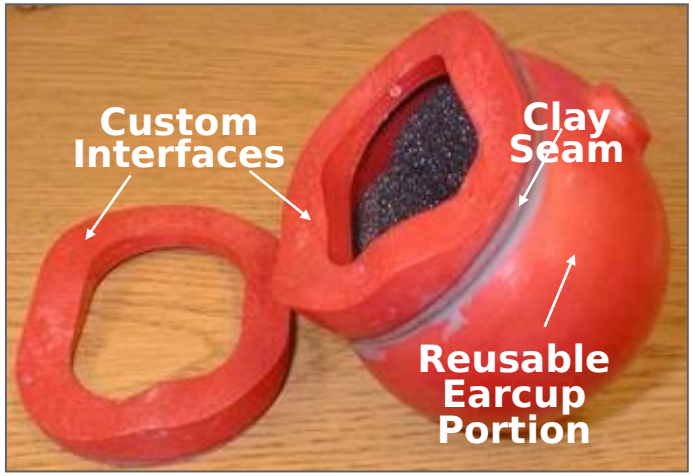
Product Description

- Intended Use: Military aviation personnel
- Primary User: Earmuff and helmet wearers
- Description: Custom and human-shaped earcup interface

Capabilities/Specifications







Availability

- In development

SAFE NOISE EXPOSURE LIMITS

DoD Instruction 6055.12: DoD Hearing Conservation Program sets a safe noise exposure limit at the ear of 85 dBA for 8-hours or equivalent exposure with a 3 dB exchange rate (each 3 dB increment halves the safe exposure durations). The table below provides safe noise exposure limits in terms of sound level at the ear (under hearing protector devices [HPD], if used) and duration. These limits will allow most people to be exposed accordingly without incurring permanent hearing loss.

Sound Level (dBA)*	Time (minutes)	Sound Level (dBA)	Time (minutes)	Sound level (dBA}	Time (minutes)
Over 115	**Must use HPD**				
115	**0.5**	**102**	**9.5**	**89**	**190**
114	**0.6**	**101**	**12**	**88**	**240**
113	**0.7**	**100**	**15**	**87**	**302**
112	**0.9**	**99**	**19**	**86**	**381**
111	**1.2**	**98**	**24**	**85**	**480**
110	**1.5**	**97**	**30**	**84**	**605**
109	**1.9**	**96**	**38**	**83****	**762**
108	**2.4**	**95**	**48**	**82****	**960**
107	**3.0**	**94**	**60**	**81****	**1210**
106	**3.8**	**93**	**76**	**80****	**24 Hours**
105	**4.7**	**92**	**95**	**Below 80**	**No limit**
104	**6.0**	**91**	**120**		
103	**7.5**	**90**	**151**		

* The A-weighted sound level is used to assess hearing damage risk due to exposure to noise. The limiting duration of exposure at any noise level at the ear (under hearing protector/s, if used) ≤115 dBA can also be determined from the equation:
Time, T (minutes) = $480 \times 2^{(85 - L_A)/3}$ where L_A = A-weighted sound level. If exposures to two or more levels occur in one day, their combined effect should not exceed an 8-hour equivalent continuous level. There should be no unprotected hearing exposure to impulse noise >140 dB.

** Noise exposures should be followed by periods of equal length in effective quiet (<75dBA).

Safe Noise Exposure

Environments				Noise Level db	Safe Noise Level Duration Times			
					Unprotected	Cranial + Foam Inserts (+30db protection)	Improved Earcups + Hard Plugs (+43db protection)	Active Noise Reduction (+50db protection)
			150 Exterior Tactical Aircraft Flight Deck Proximity	151	Exceeded	7 sec	1+53	7+30
				148		14 sec	3+45	15 min
				145		28 sec	7+30	30 min
				142		56 sec	15 min	1 hr
				139		1+53	30 min	2 hrs
				136		3+45	1 hr	4 hrs
				133		7+30	2 hrs	**8 hrs**
		130 Tactical Aircraft Cockpit		130	1 sec	15 min	4 hrs	Safe
				127	2 sec	30 min	**8 hrs**	
				124	4 sec	1 hr	Safe	
	120 Rotary/Prop Aircraft Flight Deck			121	7 sec	2 hrs		
				118	14 sec	4 hrs		
				115	28 sec	**8 hrs**		
				112	56 sec	Safe		
110 Rotary/Prop Cockpit				109	1+53			
				106	3+45			
				103	7+30			
				100	15 min			
				97	30 min			
				94	1 hr			
				91	2 hrs			
				88	4 hrs			
				85	**8 hrs**			
				82	Safe			